We claim:

1. A doped semiconductor powder comprising nanocrystals of a group IV semiconductor and a rare earth element, the rare earth element being dispersed on the surface of the group IV semiconductor nanocrystals.

2. A doped semiconductor powder according to claim 1, wherein the rare earth element is present in a concentration of from 0.5 to 10 atomic percent.

3. A doped semiconductor powder according to claim 1, wherein the rare earth element is present in a concentration of from 0.5 to 5 atomic percent.

4. A doped semiconductor powder according to claim 1, wherein the rare earth element is present in a concentration of from 0.5 to 2 atomic percent.

5. A doped semiconductor powder according to claim 1, wherein the nanocrystals have an average diameter of from 0.5 to 10 nm.

6. A doped semiconductor powder according to claim 1, wherein the nanocrystals have an average diameter of about 3 nm.

7. A doped semiconductor powder according to claim 1, wherein the group IV semiconductor is selected from Si, Ge, Sn and Pb.

8. A doped semiconductor powder according to claim 1, wherein the rare earth element is selected from cerium, praseodymium, neodymium, promethium, gadolinium, erbium, thulium, ytterbium, samarium, dysprosium, terbium, europium, holmium, lutetium, and thorium.

9. A doped semiconductor powder according to claim 1, wherein the rare earth element is selected from erbium, thulium and europium.

10. A group IV semiconductor nanocrystal powder according to claim 1, wherein the rare earth element is in the form of an oxide.

11. A process for preparing a doped semiconductor powder as claimed in claim 1, the process comprising:

(a) heating a gaseous mixture comprising a gaseous group IV semiconductor precursor and a gaseous rare earth element complex at a temperature suitable for forming group IV semiconductor nanocrystals,

(b) cooling the gaseous mixture to obtain the doped semiconductor powder.

12. A process according to claim 11, wherein the temperature is from 600 to 1000°C.

13. A process according to claim 11, wherein the gaseous mixture is cooled to room temperature.

14. A process according to claim 11, wherein the gaseous group IV semiconductor precursor comprises silicon, germanium, tin or lead.

15. A process according to claim 11, wherein the gaseous group IV semiconductor precursor is a hydride of a group IV element.

16. A process according to claim 11, wherein the gaseous group IV semiconductor precursor is silane.

17. A process according to claim 11, wherein the gaseous rare earth element complex comprises a rare earth element selected from cerium, praseodymium, neodymium, promethium, gadolinium, erbium, thulium, ytterbium, samarium, dysprosium, terbium, europium, holmium, lutetium, and thorium.

18. A process according to claim 11, wherein the gaseous rare earth element complex comprises erbium, thulium or europium.

19. A process according to claim 11, wherein the gaseous rare earth element complex comprises a ligand selected from 2,2,6,6-tetramethyl-3,5-heptanedione, acetylacetonate, flurolacetonate, 6,6,7,7,8,8,8-heptafluoro-2,2-dimethyl-3,5-octanedione, i-propylcyclopentadienyl, cyclopentadienyl, and n-butylcyclopentadienyl.

20. A process according to claim 11, wherein the gaseous rare earth element complex is selected from tris(2,2,6,6-tetramethyl-3,5-heptanedionato) erbium(III), erbium (III) acetylacetonate hydrate, erbium (III) flurolacetonate, tris(6,6,7,7,8,8,8-heptafluoro-2,2-dimethyl-3,5-octanedionate)erbium (III), tris(i-propylcyclopentadienyl)erbium (III), Tris(cyclopentadienyl)erbium (III), and tris(n-butylcyclopentadienyl)erbium (III).

21. A process according to claim 11, wherein the gaseous mixture is heated in a flow-through furnace.

22. A process for preparing a doped semiconductor powder as claimed in claim 1, the process comprising:

(a) mixing an undoped group IV semiconductor nanocrystal powder, a rare earth element complex and a solvent, the solvent being a good solvent for the rare earth element complex and a poor solvent for the undoped

group IV semiconductor nanocrystal powder, to form a heterogeneous mixture

(b) heating the heterogeneous mixture to dissolve the rare earth complex in the solvent, and

(c) cooling the heterogeneous mixture to obtain the doped semiconductor powder.

23. The process according to claim 22, wherein the undoped group IV semiconductor nanocrystal powder comprises silicon, germanium, tin or lead.

24. The process according to claim 22, wherein the undoped group IV semiconductor nanocrystal powder has an average nanocrystal diameter of from 0.5 to 10 nm.

25. The process according to claim 22, wherein the rare earth complex comprises a rare earth element selected from the group consisting of cerium, praseodymium, neodymium, promethium, gadolinium, erbium, thulium, ytterbium, samarium, dysprosium, terbium, europium, holmium, lutetium, and thorium.

26. The process according to claim 22, wherein the rare earth complex comprises erbium, europium or thulium.

27. The process according to claim 22, wherein the rare earth complex is selected from erbium acetate hydrate and erbium (III) acetylacetonate hydrate.

28. The process according to claim 22, wherein the solvent is ethanol.

29. The process according to claim 22, wherein the concentration of the rare earth complex in the heterogeneous solution if from 0.03 to 30 atomic percent.

30. The process according to claim 22, wherein the heterogeneous solution is heated for a duration of from 90 to 180 minutes.

31. The process according to claim 22, wherein the heterogeneous solution is cooled to room temperature.

32. A composite material comprising a support matrix and a doped semiconductor powder according to claim 1, the doped semiconductor powder being coated on or embedded in the support matrix.

33. A composite material according to claim 32, wherein the doped semiconductor powder is embedded in the support matrix.

34. A composite material according to claim 32, wherein the support matrix comprises spin-on-glass, a silica sol-gel or a polymer.

35. A composite material according to claim 32, wherein the support matrix is in the form of a layer prepared by spin-coating.

36. A composite material according to claim 32, wherein the support matrix comprises silicon dioxide obtained by annealing a silica sol-gel.

37. A composite material according to claim 32, wherein the support matrix is in the form of a printed pattern.